

Bruce MacDowell Maggs

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Research Interests

Networks for parallel and distributed computer systems.

Employment

Duke University

Pelham Wilder Professor of Computer Science, July 2011–present.
Professor of Computer Science, January 2010–July 2011.
Visiting Professor of Computer Science, September 2007–August 2008,
July 2009–January 2010.

Carnegie Mellon University

Adjunct Professor of Computer Science, July 2009–July 2010.
Professor of Computer Science, July 2004–July 2009.
Professor of Electrical and Computer Engineering (by courtesy), July 2004–July 2009.
Associate Professor of Computer Science, with tenure, July 1999–July 2004.
Associate Professor of Computer Science, July 1997–July 1999.
Assistant Professor of Computer Science, January 1994–July 1997.

Akamai Technologies, Inc.

Vice President for Research, January 1, 2000–present.
Vice President for Research and Development, April 1, 1999–December 31, 1999.
Senior Research Scientist, January 15, 1999–March 31, 1999.

Massachusetts Institute of Technology

Visiting Associate Professor of Computer Science, September 1998–January 1999.

NEC Research Institute, Inc.

Research Scientist (Permanent Status), October 1993–January 1994.
Research Scientist (Provisional Status), September 1990–October 1993.

Massachusetts Institute of Technology

Postdoctoral Associate, September 1989–September 1990.

Education

Massachusetts Institute of Technology

Ph.D., Computer Science, September 1989.
Thesis title: *Locality in Parallel Computation*
Thesis supervisor: Charles E. Leiserson
S.M., Electrical Engineering and Computer Science, June 1986.
Thesis title: *Communication-Efficient Parallel Graph Algorithms*
S.B., Computer Science and Engineering, June 1985.
Thesis title: *Computing Minimum Spanning Trees on a Fat-Tree Architecture*

University of Illinois at Urbana-Champaign

September 1981–May 1983.

II. Publications

Chapters in Books

- [1] “Parallel algorithms,” G. E. Blelloch and B. M. Maggs. In M. J. Atallah, editor, *Handbook of Algorithms and Theory of Computation*, CRC Press, Boca Raton, FL, November 1998, chapter 47.
- [2] “Parallel algorithms,” G. E. Blelloch and B. M. Maggs. In A. B. Tucker, Jr., editor, *The Computer Science and Engineering Handbook*, CRC Press, Boca Raton, FL, 1997, pp. 277–315.

Refereed Journal Papers

- [1] “Enabling Content-Aware Traffic Engineering,” I. Poese, B. Frank, G. Smaragdakis, S. Uhlig, A. Feldmann, and B. Maggs. *ACM SIGCOMM Computer Communication Review*, Vol. 42, No. 5, October 2012.
- [2] “Posit: A Lightweight Approach for IP Geolocation,” B. Eriksson, P. Barford, B. Maggs, and R. Nowak, *SIGMETRICS Performance Evaluation Review*, Vol. 40, No. 2, September 2012, pp. 2–11.
- [3] “Simultaneous Source Location,” K. Andreev, C. Garrod, D. Golovin, B. Maggs, and A. Meyerson. *ACM Transactions on Algorithms*, Vol. 6, No. 1, December 2009.
Originally appeared in the *Proceedings of the 7th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX)*, August, 2004.
- [4] “On the Performance Benefits of Multihoming Route Control,” A. Akella, B. M. Maggs, S. Seshan, A. Shaikh, and R. Sitaraman. *IEEE/ACM Transactions on Networking*, Vol. 16, No. 1, February 2008, pp. 91–104.
Originally appeared as “A measurement-based analysis of multihoming,” in the *Proceedings of the ACM SIGCOMM 2003 Conference on Applications, Technologies, Architectures, and Protocols for Computer Communication (SIGCOMM)*, August, 2003.
- [5] “Globally distributed content delivery,” J. Dille, B. Maggs, J. Parikh, H. Prokop, R. Sitaraman, and B. Weihl. *IEEE Internet Computing*, September/October 2002, pp. 50–58.
- [6] “Protocols for asymmetric communication channels,” M. Adler and B. M. Maggs. *Journal of Computer and Systems Sciences*, Vol. 63, No. 4, December 2001, pp. 573–596.
Originally appeared in the *Proceedings of the 39th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1998, pp. 522–533.
- [7] “On the bisection width and expansion of butterfly networks,” C. F. Bornstein, A. Litman, B. M. Maggs, R. K. Sitaraman, and T. Yatzkar. *Theory of Computing Systems*, Vol. 34, No. 6, November 2001, pp. 491–518.
Originally appeared in the *Proceedings of the 12th International Parallel Processing Symposium (IPPS)*, March 1998, pp. 144–150.
- [8] “On the benefit of supporting virtual channels in wormhole routers,” R. J. Cole, B. M. Maggs, and R. K. Sitaraman. *Journal of Computer and System Sciences*, Vol. 62, No. 1, February 2001, pp. 152–177.
Originally appeared in the *Proceedings of the 8th ACM Symposium on Parallel Algorithms and Architectures (SPAA)*, June 1996, pp. 131–141.
- [9] “Improved routing and sorting on multibutterflies,” B. M. Maggs and B. Vöcking. *Algorithmica*, Vol. 28, No. 4, 2000, pp. 438–464.

Originally appeared in the *Proceedings of the 28th Annual ACM Symposium on the Theory of Computing* (STOC), May 1997, pp. 517–530.

- [10] “Sorting-based selection algorithms for hypercubic networks,” P. Berthomé, A. Ferreira, B. M. Maggs, S. Perennes, and C. G. Plaxton. *Algorithmica*, Vol. 26, No. 2, 2000, pp. 237–254. Originally appeared in the *Proceedings of the 7th International Parallel Processing Symposium* (IPPS), April 1993, pp. 89–95.
- [11] “Fast algorithms for finding $O(\text{congestion}+\text{dilation})$ packet routing schedules,” F. T. Leighton, B. M. Maggs, and A. W. Richa. *Combinatorica*, Vol. 19, No. 3, 1999, pp. 375–401. Originally appeared in the *Proceedings of the 28th Hawaii International Conference on System Sciences* (HICSS), Volume 2, January, 1995, pp. 555–563.
- [12] “Simple algorithms for routing on butterfly networks with bounded queues,” B. M. Maggs and R. K. Sitaraman. *SIAM Journal on Computing*, Vol. 28, No. 3, June 1999, pp. 984–1003. Originally appeared in the *Proceedings of the 24th Annual ACM Symposium on the Theory of Computing* (STOC), May 1992, pp. 150–161.
- [13] “Tight analyses of two local load balancing algorithms,” B. Ghosh, F. T. Leighton, B. M. Maggs, S. Muthukrishnan, C. G. Plaxton, R. Rajaraman, A. W. Richa, R. E. Tarjan, and D. Zuckerman. *SIAM Journal on Computing*, Vol. 29, No. 1, February 1999, pp. 29–64. Originally appeared in the *Proceedings of the 27th Annual ACM Symposium on the Theory of Computing* (STOC), May 1995, pp. 548–558.
- [14] “On the fault tolerance of some popular bounded-degree networks,” F. T. Leighton, B. M. Maggs, and R. K. Sitaraman. *SIAM Journal on Computing*, Vol. 27, No. 5, October 1998, pp. 1303–1333. Originally appeared in the *Proceedings of the 33rd Annual Symposium on Foundations of Computer Science* (FOCS), October 1992, pp. 542–552.
- [15] “An experimental analysis of parallel sorting algorithms,” G. E. Blelloch, C. E. Leiserson, B. M. Maggs, C. G. Plaxton, S. Smith, and M. Zagha. *Theory of Computing Systems*, Vol. 31, No. 2, March/April 1998, pp. 135–167. Originally appeared as “A comparison of sorting algorithms for the Connection Machine CM-2,” in the *Proceedings of the 3rd Annual ACM Symposium on Parallel Algorithms and Architectures* (SPAA), July 1991, pp. 3–16.
- [16] “Reconfiguring arrays with faults part I: worst-case faults,” R. J. Cole, B. M. Maggs, and R. K. Sitaraman. *SIAM Journal on Computing*, Vol. 26, No. 6, December 1997, pp. 1581–1611. Originally appeared as “Multi-scale emulation: A technique for reconfiguring arrays with faults,” in the *Proceedings of the 25th Annual ACM Symposium on the Theory of Computing* (STOC), May 1993, pp. 561–572.
- [17] “Work-preserving emulations of fixed-connection networks,” R. R. Koch, F. T. Leighton, B. M. Maggs, S. B. Rao, A. L. Rosenberg, and E. J. Schwabe. *Journal of the ACM*, Vol. 44, No. 1, January 1997, pp. 104–147. Originally appeared in the *Proceedings of the 21st Annual ACM Symposium on Theory of Computing* (STOC), May 1989, pp. 227–240.
- [18] “On-line algorithms for path selection in a nonblocking network,” S. Arora, F. T. Leighton, and B. M. Maggs. *SIAM Journal on Computing*, Vol. 25, No. 3, June 1996, pp. 600–625. Originally appeared in the *Proceedings of the 22nd Annual ACM Symposium on Theory of Computing* (STOC), May 1990, pp. 149–158.

- [19] “A maximum likelihood stereo algorithm,” I. J. Cox, S. L. Hingorani, B. M. Maggs, S. B. Rao. *Computer Vision and Image Understanding*, Vol. 63, No. 3, May 1996, pp. 542–567. Originally appeared as “Stereo without disparity gradient smoothing: a Bayesian sensor fusion solution,” in D. Hogg and R. Boyle, ed., *Proceedings of the British Machine Vision Conference*, Springer-Verlag, September 1992, pp. 337–346.
- [20] “Randomized routing and sorting on fixed-connection networks,” F. T. Leighton, B. M. Maggs, S. B. Rao, and A. G. Ranade. *Journal of Algorithms*, Vol. 17, No. 1, July 1994, pp. 157–205. Originally appeared as “Universal packet routing algorithms,” T. Leighton, B. Maggs, and S. Rao. *Proceedings of the 29th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1988, pp. 256–271. Note: this conference paper was later broken into two journal papers.
- [21] “Packet routing and job-shop scheduling in $O(\text{congestion}+\text{dilation})$ steps,” F. T. Leighton, B. M. Maggs, S. B. Rao. *Combinatorica*, Vol. 14, No. 2, 1994, pp. 167–180. Originally appeared as “Universal packet routing algorithms,” T. Leighton, B. Maggs, and S. Rao. *Proceedings of the 29th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1988, pp. 256–271. Note: this conference paper was later broken into two journal papers.
- [22] “A parallel algorithm for reconfiguring a multibutterfly network with faulty switches,” A. V. Goldberg, B. M. Maggs, and S. A. Plotkin. *IEEE Transactions on Computers*, Vol. 43, No. 3, March 1994, pp. 321–326.
- [23] “Fast algorithms for routing around faults in multibutterflies and randomly-wired splitter networks,” F. T. Leighton and B. M. Maggs. *IEEE Transactions on Computers*, Vol. 41, No. 5, May 1992, pp. 578–587. Originally appeared as “Expanders might be practical: fast algorithms for routing around faults on multibutterflies,” in the *Proceedings of the 30th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1989, pp. 384–389.
- [24] “Fast algorithms for bit-serial routing on a hypercube,” W. A. Aiello, F. T. Leighton, B. M. Maggs, and M. Newman. *Mathematical Systems Theory*, Vol. 24, No. 4, 1991, pp. 253–271. Originally appeared in the *Proceedings of the 2nd Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA)*, July 1990, pp. 55–64.
- [25] “Communication-efficient parallel algorithms for distributed random-access machines,” C. E. Leiserson and B. M. Maggs. *Algorithmica*, Vol. 3, No. 1, 1988, pp. 53–77. Originally appeared in the *Proceedings of the 1986 International Conference on Parallel Processing (ICPP)*, August 1986, pp. 861–868.
- [26] “Minimum-cost spanning tree as a path-finding problem,” B. M. Maggs and S. A. Plotkin. *Information Processing Letters*, Vol. 26, No. 6, January 1988, pp. 291–293.

Submitted for Journal Publication

- [1] “Designing overlay multicast networks for streaming”, K. Andreev, B. Maggs, A. Meyerson, and R. Sitaraman. Originally appeared in *Proceedings of the Fifteenth Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA)*, June 2003.
- [2] “On hierarchical routing in doubling metrics,” H. T-H. Chan, A. Gupta, B. M. Maggs, and S. Zhou.

Originally appeared in *Proceedings of the 16th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2005.

Refereed Conference and Workshop Papers Not Also Appearing in or Submitted to Journals

- [1] “Less pain, most of the gain: incrementally deployable ICN,” S. Fayazbaksh, Y. Lin, A. Tootonchian, A. Ghodsi, T. Koponen, B. Maggs, K.-C. Ng, V. Sekar, and S. Shenker, *Proceedings of the ACM SIGCOMM 2013 Conference (SIGCOMM)*, August, 2013, to appear.
- [2] “Reliable content-distribution networks,” P. Aditya, M. Zhao, Y. Lin, A. Haeberlen, P. Druschel, B. Maggs, and B. Wishon, *Proceedings of the 9th USENIX Symposium on Networked Systems Design and Implementation (NSDI)*, April 2012.
- [3] “Cutting the electrical bill for Internet-scale systems,” A. Qureshi, R. Weber, H. Balakrishnan, J. Guttag, and B. Maggs, *Proceedings of the ACM SIGCOMM 2009 Conference (SIGCOMM)*, August, 2009.
- [4] “Holistic query transformations for dynamic Web applications,” A. Manjhi, C. Garrod, B. M. Maggs, T. C. Mowry, and A. Tomasic, *Proceedings of the 2009 IEEE 25th International Conference on Data Engineering (ICDE)*, April 2009.
- [5] “Holistic application analysis for update-independence,” C. Garrod, A. Manjhi, B. Maggs, T. Mowry, and A. Tomasic, *Proceedings of the Second IEEE Workshop on Hot Topics in Web Systems and Technologies (HotWeb 2008)*, October, 2008, pp. 1–6.
- [6] “Scalable query result caching for Web applications,” C. Garrod, A. Manji, A. Ailamaki, B. Maggs, T. Mowry, C. Olston, and A. Tomasic. *Proceedings of the 34th International Conference on Very Large Databases (VLDB)*, August 2008.
- [7] “On the impact of route monitor selection,” Y. Zhang, Z. Zhang, Z. M. Mao, Y. C. Hu, and B. M. Maggs, *Proceedings of the Internet Measurement Conference 2007 (IMC)*, October 2007.
- [8] “Portcullis: protecting connection setup from denial-of-capability attacks,” B. Parno, D. Wendlandt, E. Shi, A. Perrig, B. Maggs, and Y.-C. Hu, *Proceedings of the ACM SIGCOMM 2007 Conference (SIGCOMM)*, August, 2007.
- [9] “R-BGP: staying connected in a connected world,” N. Kushman, S. Kandula, D. Katabi, and B. M. Maggs, *Proceedings of the 4th USENIX Symposium on Networked Systems Design & Implementation (NSDI)*, April 2007.
- [10] “Invalidation clues for database scalability services,” A. Manjhi, P. B. Gibbons, A. Ailamaki, B. M. Maggs, T. C. Mowry, C. Olston, A. Tomasic, and H. Yu. *Proceedings of the 2007 IEEE 23rd International Conference on Data Engineering (ICDE)*, April 2007.
- [11] “Quorum placement in networks: minimizing network congestion,” D. Golovin, A. Gupta, B. M. Maggs, F. Oprea, and M. Reiter, *Proceedings of the 18th Annual ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing (PODC)*, July, 2006.
- [12] “Simultaneous scalability and security for data-intensive Web applications,” A. Manjhi, A. Ailamaki, B. M. Maggs, T. C. Mowry, C. Olston, and A. Tomasic. *Proceedings of ACM SIGMOD 2006 (SIGMOD)*, June, 2006.
- [13] “Finding effective support-tree preconditioners,” B. M. Maggs, G. L. Miller, O. Parekh, R. Ravi, and S. L. M. Woo. *Proceedings of the 17th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA)*, July 2005.

- [14] “Quorum placement in networks to minimize access delays,” A. Gupta, B. Maggs, F. Oprea, and M. Reiter, *Proceedings of the 17th Annual ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing (PODC)*, July, 2005.
- [15] “A scalability service for dynamic Web applications,” C. Olston, A. Manjhi, C. Garrod, A. Ailamaki, B. M. Maggs, and T. C. Mowry, *Proceedings of the 2nd Biennial Conference on Innovative Data Systems Research (CIDR)*, January 2005.
- [16] “A methodology for estimating interdomain Web traffic demand,” A. Feldmann, N. Kammenhuber, O. Maennel, B. Maggs, R. De Prisco, and R. Sundaram. *Proceedings of the Internet Measurement Conference 2004 (IMC)*, October 2004.
- [17] “An analysis of live streaming workloads on the Internet,” K. Sripanidkulchai, B. Maggs, and H. Zhang. *Proceedings of the Internet Measurement Conference 2004 (IMC)*, October 2004.
- [18] “Availability, usage, and deployment characteristics of the Domain Name System”, J. Pang, J. Hendricks, A. Akella, S. Seshan, B. Maggs, and R. De Prisco. *Proceedings of the Internet Measurement Conference 2004 (IMC)*, October 2004.
- [19] “Locating Internet routing instabilities”, A. Feldmann, O. Maennel, Z. Morley Mao, A. Berger, and B. Maggs. *Proceedings of the ACM SIGCOMM 2004 Conference (SIGCOMM)*, August, 2004.
- [20] “A comparison of overlay routing and multihoming route control”, A. Akella, J. Pang, A. Shaikh, B. Maggs, and S. Seshan. *Proceedings of the ACM SIGCOMM 2004 Conference (SIGCOMM)*, August, 2004.
- [21] “The feasibility of supporting large-scale live streaming applications with dynamic application end-points,” K. Sripanidkulchai, A. Ganjam, B. Maggs, and H. Zhang. *Proceedings of the ACM SIGCOMM 2004 Conference (SIGCOMM)*, August, 2004.
- [22] “Efficient content location using interest-based locality in peer-to-peer systems”, K. Sripanidkulchai, B. M. Maggs, and H. Zhang. *Proceedings of the 22nd Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM’03)*, April 2003.
- [23] “Space-efficient finger search on degree-balanced search trees”, G. E. Blelloch, B. M. Maggs, and S. L. M. Woo. *Proceedings of the 14th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2003, pp. 374–383.
- [24] “Tradeoffs between parallelism and fill in nested dissection,” C. F. Bornstein, B. M. Maggs, and G. L. Miller, *Proceedings of the Eleventh Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA)*, June 1999, pp. 191–200.
- [25] “On balls and bins with deletions,” R. Cole, A. Frieze, B. M. Maggs, M. Mitzenmacher, A. W. Richa, R. K. Sitaraman, and E. Upfal, *Proceedings of the 2nd International Workshop on Randomization and Approximation Techniques in Computer Science (RANDOM)*, October 1998, pp. 145–158.
- [26] “Randomized protocols for low-congestion circuit routing in multistage interconnection networks,” R. Cole, B. M. Maggs, F. Meyer auf der Heide, M. Mitzenmacher, A. W. Richa, K. Schröder, R. K. Sitaraman, and B. Vöcking. *Proceedings of the 29th Annual ACM Symposium on the Theory of Computing (STOC)*, May 1998, pp. 378–388.
- [27] “Parallel Gaussian elimination with linear work and fill,” C. F. Bornstein, B. M. Maggs, G. Miller, and R. Ravi. *Proceedings of the 38th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1997, pp. 274–283.

- [28] “Exploiting locality for data management in systems of limited bandwidth,” B. M. Maggs, F. Meyer auf der Heide, B. Vöcking, and M. Westermann. *Proceedings of the 38th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1997, pp. 284–293.
- [29] “Routing on butterfly networks with random faults,” R. Cole, B. Maggs, and R. Sitaraman. *Proceedings of the 36th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1995, pp. 558–570.
- [30] “An algorithm for finding predecessors in integer sets,” B. Maggs and M. Rauch. *Proceedings of the 3rd Workshop on Algorithms and Data Structures (WADS)*. Vol. 709 of Lecture Notes in Computer Science, Springer-Verlag, August 1993, pp. 483–493.
- [31] “Approximate load balancing on dynamic and asynchronous networks,” W. Aiello, B. Awerbuch, B. Maggs, and S. Rao. *Proceedings of the 25th Annual ACM Symposium on the Theory of Computing (STOC)*, May 1993, pp. 632–641.
- [32] “Empirical evaluation of randomly-wired multistage networks,” D. Lisinski, T. Leighton, and B. Maggs. *Proceedings of the 1990 International Conference on Computer Design (ICCD)*, September 1990, pp. 380–385.

Technical Reports

- [1] “Competitive analysis of call admission algorithms that allow delay,” A. Feldmann, B. M. Maggs, J. Sgall, D. D. Sleator, and A. Tomkins. Technical Report CMU-CS-95-102, School of Computer Science, Carnegie Mellon University, Pittsburgh, PA 15213, January 1995.

Other Publications - Surveys and Position Papers

- [1] “A survey of congestion+dilation results for packet scheduling,” B. M. Maggs. *Proceedings of the 40th Conference on Information Science and Systems (CISS)*, March 2006.
- [2] “Real-time emulations of bounded-degree networks,” B. M. Maggs and E. J. Schwabe, *Information Processing Letters*, Vol. 6, No. 5, June 1998, pp. 269–276.
- [3] “A critical look at three of parallel computing’s maxims,” B. M. Maggs. *Proceedings of the 1996 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN ’96)*, June 1996, pp. 1–7.
- [4] “Parallel algorithms,” G. E. Blelloch and B. M. Maggs, *ACM Computing Surveys*, Vol. 28, No. 1, March 1996, pp. 51–54.
- [5] “Models of parallel computation: a survey and synthesis,” B. M. Maggs, L. R. Matheson, and R. E. Tarjan. *Proceedings of the 28th Hawaii International Conference on System Sciences (HICSS)*, Volume 2, January, 1995, pp. 61–70.
- [6] “The hidden cost of low bandwidth communication,” G. E. Blelloch, B. M. Maggs, and G. L. Miller. In U. Vishkin, ed., *Developing a Computer Science Agenda for High-Performance Computing*, ACM Press, 1994, pp. 22–25.
- [7] “Randomly wired multistage networks.” *Statistical Science*, B. M. Maggs. Vol. 8, No. 1, February, 1993, pp. 70–75.
- [8] “Beyond parallel random-access machines,” B. M. Maggs. In J. L. C. Sanz, ed., *Opportunities and Constraints of Parallel Computing*, Springer-Verlag, 1989, pp. 83–84.

Patents

- U.S. Patent Number 7,296,082, “Method and System for Fault Tolerant Media Streaming over the Internet,” F. T. Leighton, D. M. Lewin, D. Shaw, and B. Maggs, November 13, 2007.
- U.S. Patent Number 7,111,061, “Global Load Balancing Across Mirrored Data Centers,” F. T. Leighton, A. E. Lewin (legal representative), R. Sundaram, R. S. Dhanidina, R. Kleinberg, M. Levine, A. M. Soviani, B. Maggs, H. S. Rahul, S. Thirumalai, J. G. Parikh, Y. O. Yerushalmi, D. M. Lewin, September 19, 2006.
- U.S. Patent Number 7,010,578, “Internet Content Delivery Service with Third Party Cache Interface Support,” D. M. Lewin, B. Maggs, and J. J. Kloninger, March 7, 2006.
- U.S. Patent Number 6,667,726, “Method and System for Fault Tolerant Media Streaming over the Internet,” F. T. Leighton, D. M. Lewin, D. Shaw, and B. Maggs, December 16, 2003.
- U.S. Patent Number 5,521,591, “Switching Networks with Expansive and/or Dispersive Logical Clusters for Message Routing,” S. A. Arora, T. F. Knight, Jr., F. T. Leighton, B. M. Maggs, and E. Upfal, May 28, 1996.

III. Evidence of External Reputation

Awards

- Daniel L. Slotnick Award for Most Original Paper for “Communication-efficient parallel graph algorithms,” C. E. Leiserson and B. M. Maggs, *Proceedings of the 1986 International Conference on Parallel Processing*, August 1986, IEEE, pp. 861–868.

Distinguished Lecture Series Talks

- “Cutting the Electrical Bill for Internet-Scale Systems,”
AT & T Labs Research (7/10)
- “Lessons in Engineering Self-Managing Networks,”
Microsoft Research Silicon Valley (11/07)
- “Experimenting with a Content Delivery Network”
Boston University (11/03),
Johns Hopkins University (11/03)
- “Global Internet Content Delivery”
University of Illinois at Chicago (12/02),
IBM Silicon Valley Laboratory (5/02).
- “Some Problems Related to Content Delivery”
University of Massachusetts, Amherst (10/01).

Keynote Addresses at Conferences and Workshops

- “A First Look at a Commercial Hybrid Content Delivery System,”
15th IEEE Global Internet Symposium (3/12).
- “Cutting the Electric Bill for Internet-Scale Systems,”
Student Workshop, 6th International Conference on emerging Networking EXperiments and Technologies (CoNEXT) (11/10).

- “Challenges in Engineering the World’s Largest Content Delivery Network,”
Second IEEE Workshop on Hot Topics in Web Systems and Technologies (10/08).
- “Engineering a Large Self-Managed Network,”
Tag der Informatik, Rheinisch-Westfälische Technische Hochschule Aachen (12/07).
- “A Scalable Approach to Alleviating Database Bottlenecks”
Third Annual Delis Workshop (1/07).
- “A Methodology for Estimating Interdomain Web Traffic”
Heinz Nixdorf Symposium (1/06).
- “Lessons in Engineering Self-Managing Networks,”
Microsoft Self-Managing Networks Summit, 2005: Making Networks Self-Aware (6/05).
- “A Comparison of Overlay Routing and Multihoming Route Control,”
High Performance Switching and Routing Workshop, (04/04),
- “Designing Overlay Multicast Networks for Streaming”,
Tenth International Colloquium on Structural Information and Communication Complexity (SIROCCO 2003) (6/03).
- “Some Problems Related to Content Delivery”
ACM/IEEE International Symposium on Cluster Computing and the Grid (CC-Grid2001) (5/01),
Third NYC Metro Area Distributed Systems Meeting (NMADS-3) (04/01),
International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '00) (12/00),
Ninth IEEE International Symposium on High Performance Distributed Computing (HPDC) (8/00).
- “Global Internet Content Delivery”
21st Annual ACM Symposium on Principles of Distributed Computing (PODC '02) (7/02),
INFORMATIK '99, International Workshop on Communication and Data Management in Large Networks, Heinz Nixdorf Institute, University of Paderborn, Paderborn, Germany (10/99).
- “Multibutterflies: The Most Powerful Multistage Interconnection Networks Known”
Computing: the Australasian Theory Symposium, Sydney, Australia (2/97).
- “Improved Routing and Sorting on Multibutterflies”
Midwest Theory Day, Chicago, IL (12/96).
- “A Critical Look at Three of Parallel Computing’s Maxims”
1996 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '96), Beijing, China (6/96).
- “What Makes a Good Routing Network?”
International Workshop on Interconnection Networks, Centre International de Rencontres Mathématiques, Luminy, France (7/95).

One-Hour Plenary Session Invited Lectures at Conferences and Workshops

- “Designing Overlay Multicast Networks for Commercial Streaming”
Workshop on Network Management and Design, Institute for Mathematics and its Applications (IMA), University of Minnesota (5/03).

- “Challenges in Building a Reliable System of Tens of Thousands of Servers”
Dependability in Real Life, Second High Dependability Computing Consortium Workshop (5/01).
- “Variations on Nested Dissection”
Symposium on High Performance Computing and Networks, Fordham University (3/99).
- “Protocols for Asymmetric Communication Channels”
Symposium on Parallel and Distributed Computing and Networks, National University of Singapore (7/98).
- “Multibutterflies: The Most Powerful Multistage Interconnection Networks Known”
Workshop on Complexity Issues in Distributed and Parallel Computation, Fields Institute, Toronto, Canada (6/98).
- “Work-Preserving Network Emulations”
2nd Workshop on Parallel Algorithms (WOPA), New Orleans, LA (5/91).

Invited Lectures in Academia and Industry

- “A First Look at a Commercial Hybrid Content Delivery System,”
Microsoft Research, Redmond, WA(10/11), University of Illinois (7/11), Technische Universität Berlin / Deutsche Telekom Laboratories, Berlin, Germany (6/11), Internet Multi-Resolution Analysis Reunion Conference, Lake Arrowhead, CA (6/11).
- “Cutting the Electric Bill for Internet-Scale Systems,”
Technische Universität Berlin / Deutsche Telekom Laboratories, Berlin, Germany (12/10), LIP6 (Laboratoire d’Informatique de Paris 6), Paris, France (9/09), Max Planck Institute for Software Systems, Saarbrücken, Germany (9/09).
- “A Content Delivery Network’s Experiences with Denial of Service Attacks,” International Conference on Cyber Security, New York, NY (8/10).
- “Measurements and their Application in a Content Delivery Network,” Internet Multi-Resolution Analysis Culminating Retreat, Lake Arrowhead, CA (12/08).
- “Engineering a Large Self-Managed Network,”
University of California at Irvine (1/08).
- “Work-Preserving Network Emulations”
Army Fest: A Celebration of Arnold Rosenberg’s Distinguished Career, University of Massachusetts at Amherst (10/07).
- “R-BGP: Staying Connected in a Connected World”,
KAIST Networking Seminar Series (KNSS 2007), Daejeon, Republic of Korea (9/07), Duke University, (3/09).
- “A Scalable Approach to Alleviating Database Bottlenecks”
Duke University (10/06), LIP6 (Laboratoire d’Informatique de Paris 6), Paris, France (1/07).
- “A Methodology for Estimating Interdomain Web Traffic”
Massachusetts Institute of Technology (2/05).
- “Using Akamai Traces to Drive End System Multicast Simulations”
Workshop on Building Scalable Simulations of Complex Socio-Technical Systems, 5th Symposium of the Los Alamos Computer Science Institute (LACSI) (11/04).

- “Designing Overlay Multicast Networks for Streaming”
Arizona State University (4/04), University of California at Berkeley (4/04), Northeastern University (11/03), Technical University of Munich (9/03).
- “How Akamai Uses Consistent Hashing”
Special Session on Probabilistic Methods in Combinatorics and the Internet, 108th Annual Meeting of the American Mathematical Society (AMS), (1/02).
- “Content Delivery on September 11”
The Internet Under Crisis Conditions: Learning from the Impact of September 11, a Computer Science and Telecommunications Board Workshop, National Research Council (3/02).
- “Some Problems Related to Content Delivery”
Northeastern University (4/01), The College of William and Mary (4/01), University of California, San Diego (1/01), University of Southern California (9/00), University of Arizona (9/00), Arizona State University (9/00), University of California, Santa Barbara (5/00).
- “Global Internet Content Delivery”
Stanford University (5/02), Lucent Bell Laboratories (11/99), University of Michigan (11/99),
- “Using Internet Measurements to Direct Clients to Servers”
OPENSIG '99 Workshop, Open Signalling for ATM, Internet and Mobile Networks, Pittsburgh, PA (10/99).
- “Variations on Nested Dissection”
National Cheng Kung University, Tainan, Taiwan (7/99), Heinz Nixdorf Institute, University of Paderborn, Paderborn, Germany (12/98), Massachusetts Institute of Technology (9/98),
- “Protocols for Asymmetric Communication Channels”
Universidade Federal do Rio de Janeiro (3/00), Dagstuhl-Seminar on Parallel and Distributed Algorithms (7/99), Massachusetts Institute of Technology (10/98), Northeastern University (10/98), Cornell University (2/98).
- “Multibutterflies: The Most Powerful Multistage Interconnection Networks Known”
Special Session on Interconnection Networks, International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '00), (12/00), Department of Computer and Information Engineering, National Sun Yat-Sen University, Kaohsiung, Taiwan (7/98), Kent Ridge Digital Laboratories, National University of Singapore (7/98), AT&T Labs Research (2/98), Academia Sinica, Nankang, Taiwan (12/97), National Chiao Tung University, Hsinchu, Taiwan (12/97), University of Texas at Austin (8/97), Massachusetts Institute of Technology (5/97), India Institute of Technology, Bombay, India (1/97).
- “A Critical Look at Three of Parallel Computing’s Maxims”
University of Illinois at Chicago (12/96), Beijing University of Aeronautics and Astronautics (6/96), IBM Tokyo Research Laboratory (6/96).
- “What Makes a Good Routing Network?”
New York Academy of Sciences (1/96), Massachusetts Institute of Technology (11/95).
- “Reconfiguring Parallel Computers with Faulty Components,”
University of Waterloo, Waterloo, Canada (3/95), University of Aizu, Aizu-Wakamatsu, Japan (12/94), National Tsing Hua University, Hsinchu, Taiwan (12/94), Academia

Sinica, Nankang, Taiwan (12/94), The Johns Hopkins University (12/94), New Jersey Institute of Technology (4/94), University of Texas at Austin (12/93), University of Central Florida (10/93), Dagstuhl-Seminar on Parallel and Distributed Algorithms (9/93), Universität des Saarlandes, Saarbrücken, Germany (9/93), DIMACS Workshop on Parallel Algorithms for Unstructured and Dynamic Problems (6/93), Princeton University (4/93), Massachusetts Institute of Technology (4/93), University of Pennsylvania (2/93).

“Simple Algorithms for Routing on Butterfly Networks with Bounded Queues,”
University of Maryland (4/92).

“A Comparison of Sorting Algorithms for the Connection Machine CM-2,”
University of Massachusetts (3/93), New York University (11/92), University of Illinois (4/92), University of British Columbia (2/92).

“Asymptotically Optimal Schedules for Packet Routing,”
SIAM Annual Meeting, Chicago, IL (7/90).

“Fault-Tolerant Routing Algorithms for Multibutterfly Networks,”
NEC C & C Research Laboratories, Yokohama, Japan (8/91), ACM Symposium on Gigabit Networks, Washington, DC (7/91), SIAM Int. Conf. on Industrial and Applied Math., Washington, DC (7/91), University of Maryland (2/91), University of Illinois (1/91), Washington University, St. Louis (1/91), Harvard University (4/90), Cornell University (4/90), AT & T Bell Laboratories (3/90), Duke University (2/90), IBM Thomas J. Watson Research Center (2/90), Rice University (2/90), Bell Communications Research (2/90), NEC Research Institute (1/90), Yale University (12/89).

“Universal Packet Routing Algorithms,”
Microelectronics Consortium of North Carolina (2/90), Fordham University (2/89),
IBM Thomas J. Watson Research Center (2/89).

“Communication-Efficient Parallel Graph Algorithms,”
Southern Methodist University (8/86), Massachusetts Institute of Technology (4/86).

Tutorials

“Content Delivery Networks,” 7th Annual IEEE Consumer Communications & Networking Conference, Las Vegas, NV (1/10).

Summer School Lectures

School on Models and Algorithms for the WWW, International Center for Mechanical Sciences (CISM), Udine, Italy, (6/02).

“Internet Content Delivery”

“Content Delivery on 9/11”

“Delivering Streaming Content on the Internet”

“Challenges in Building a Reliable System with Tens of Thousands of Servers”

“A Little Bit about Akamai’s Business”

“Akarouting: A Better Way to Go”

School on the Foundations of Computer Science (ADFOCS), Max-Planck Institute, Saarbrücken, Germany, (9/01).

“Challenges in Building a Reliable System with Tens of Thousands of Servers”

“Delivering Streaming Content on the Internet”

Short Course on Networking, National Sun Yat-Sen University, Kaohsiung, Taiwan (7/99).

“Theory of Interconnection Networks I”

“Theory of Interconnection Networks II”

“Theory of Interconnection Networks III”

“Universal Routing Algorithms”

“Routing on the Internet”

“Streaming Media”

Summer Institute on Parallel and Distributed Computing, Academia Sinica, Nankang, Taiwan (7/98).

“Variations on Nested Dissection”

“Exploiting Locality for Data Management in Networks of Limited Bandwidth”

“On the Bisection Width and Expansion of Butterfly Networks”

“Protocols for Asymmetric Communication Channels”

“Multibutterflies: The Most Powerful Multistage Interconnection Networks Known”

Summer School on Architectures and Programming Paradigms for Parallel Computers, Padova Ricerche, Padova, Italy (6/96).

“Universal Routing Algorithms”

Consulting

Vinson & Elkins

Consultant in GeoTag, Inc., v. Frontier Communications Corp. et al., for Bare Escentuals, Christian Dior Perfumes, Crabtree & Evelyn, Gold’s Gym, Panera, Sephora, and 7-Eleven, April 2013–present.

Edwards Wildman Palmer

Consultant in Joseph Robert Marchese d/b/a JDS Digital Security Systems, Inc., v. Milestone Systems, Inc., for Milestone Systems, February 2013–present

Quinn Emanuel Urquhart & Sullivan

Expert witness in Vasudevan Software, Inc., v. Microstrategy, Inc., for Microstrategy, January 2013–present.

Weil Gotshal & Manges

Expert witness in Soverain Software, LLC, v. eBay et al. for eBay, November 2012–present.

Haltom & Doan

Consultant in Portal Technologies, LLC, v. Yahoo!, Inc., for Yahoo!, October 2012–March 2013.

McDermott Will & Emery

Expert witness in Innovative Communication Technologies, Inc., v. ooVoo LLC, for ooVoo. September 2012–November 2012.

Latham & Watkins

Expert witness in Innovative Communication Technologies, Inc., v. Vivox, Inc., for Vivox. September 2012–November 2012.

Wiley Rein

Expert witness in Innovative Communication Technologies, Inc., v. Stalker Software d/b/a CommuniGate Systems, Inc., for Stalker. September 2012–November 2012.

Weil Gotshal & Manges, et. al

Expert witness in Site Update Solutions, Inc. v. Adobe Systems et al., for Adobe Systems, et al., April 2012–present.

Haltom & Doan

Expert witness in Droplets, Inc. v. Amazon.com, Inc., et al., for Yahoo!, April 2012–present.

Quinn Emanuel Urquhart & Sullivan

Expert witness in Finjan, Inc. v. McAfee, Inc., et al., for Symantec, October 2011–December 2012. Was deposed, testified at trial.

Quinn Emanuel Urquhart & Sullivan

Expert witness in DDB Technologies, LLC v. CSTV Networks, Inc., et al., for CSTV Networks, May 2012–present.

Vinson & Elkins

Expert witness in DDB Technologies, LLC v. Fox Sports Interactive Media, LLC, for Fox Sports, January 2012–present.

Vinson & Elkins

Expert witness in Realtime Data, LLC v. Morgan Stanley, et al., for Thomson Reuters, September 2011–September 2012. Was deposed.

Banner & Witcoff

Consultant in Augme Technologies, Inc. v. Pandora Media Inc., for Pandora, October 2011–February 2013.

Fish & Richardson

Expert witness in Eolas Technologies, Inc. v. Adobe Systems, Inc., et al., for Go Daddy, August 2011–February 2012. Was deposed.

Weil, Gotshal & Manges

Expert witness in Eolas Technologies, Inc. v. Adobe Systems, Inc., et al., for Yahoo! and Amazon, July 2011–February 2012. Was deposed.

Banner & Witcoff

Consultant in Jagex Ltd. v. Impulse Software, Eric Snellman, and Mark Snellman, for Jagex, June 2011–November 2011.

Quinn Emanuel Urquhart & Sullivan

Expert Witness in BackWeb Technologies, Ltd. v. International Business Machines Corporation, for IBM and Hewlett Packard, May 2011–November 2011. Testified at technical tutorial.

O'Melveny & Myers

Consultant in Interval Licensing LLC v. AOL, Inc., et al., for Apple, Google, Yahoo!, and America Online, April 2011–present.

DLA Piper

Expert witness in Eolas Technologies, Inc. v. Adobe Systems, Inc., et al., for Oracle, January 2011–April 2011. Was deposed.

Hogan Lovells et al.

Expert witness in DDB Technologies, LLC v. ESPN, Inc., et al., for ESPN, NFL, NHL, NBA, PGA, Yahoo!, and America Online, January 2011–May 2011. Testified in technical tutorial and at Markman hearing.

O'Melveny & Myers

Consultant in inter partes reexamination, for Apple, August 2010–June 2011.

Novak, Druce + Quigg

Consultant in TMC Patents v. Sun Microsystems, for Sun Microsystems, September 2009–January 2011.

Wilmer Cutler Pickering Hale and Dorr

Expert witness in Beneficial Innovations, Inc., v. AOL LLC, et al., for Google, September 2009–November 2010.

Banner & Witcoff

Expert witness in Zamora Radio LLC v. Last.fm et al., for Pandora Media, September 2009–November 2010.

O'Melveny & Meyers

Expert witness in private arbitration involving console-based video games, July 2008–April 2009. Was deposed, testified at arbitration hearing.

Banner & Witcoff

Expert witness in MOAEC, Inc., v. Pandora Media, Inc., et al., for Pandora, June 2008–April 2009. Was deposed.

Jenner & Block

Consultant in Adams vs. Dell, Inc., et al., for Dell, July 2008–April 2009.

Banner & Witcoff

Consultant in WebXchange, Inc., v. The Allstate Corporation, et al., for Allstate, April 2008–October 2009.

Irell & Manella

Consultant in Peer Communications Corp., v. eBay Inc., Skype Technologies SA, Skype, Inc., for Skype and eBay, March 2008–November 2008.

Irell & Manella

Expert witness in Net2Phone, Inc., v. eBay Inc., Skype Technologies SA, Skype, Inc., and John Does 1-10, for Skype and eBay, January 2008–September 2010. Was deposed, testified at evidentiary hearing.

Banner & Witcoff

Expert witness in Riparius Ventures LLC v. Ascalade Communications, Inc., Logitech International S.A., Koninklijke Philips Electronics N.V., U.S. Robotics and Cisco Systems, Inc., for Logitech, U.S. Robotics, and Cisco, Fall 2007–present.

Banner & Witcoff

Expert witness in Team Play, Inc., P&P Marketing, Inc., and Cosmodog, LTD. v. Stephen Boyer, d/b/a Skyboy Productions, for Team Play, September 2004–November 2004.

Toshiba, Inc.

Consultant, April 2005–August 2005.

Banner & Witcoff

Expert witness in Windy City Innovations, LLC, v. America Online, Inc., for America Online, August 2004–November 2005. Was deposed.

Jenner & Block

Consultant in IP Learn v. SkillSoft Corporation, for SkillSoft, January 2003–May 2003.

Morrison & Forster

Consultant in Yahoo!, Inc., v. NCR Corporation, for Yahoo!, February 2003–September 2003.

Jenner & Block

Helped defend against threat of patent litigation, January 2003–June 2003.

Banner & Witcoff

Expert witness in *Lexmark, Inc., v. Static Control Components*, for Lexmark, January 2003–November 2006. Was deposed, testified at preliminary injunction hearing.

FreeMarkets, Inc.

Helped defend against threat of patent litigation, October 2002–January 2003.

Newport Opticom, Inc.

Helped design multistage optical interconnection network, Fall 2001.

Democratic National Committee

Helped to architect the DNC's web-site infrastructure, Spring 2001.

Thinking Machines, Inc.

Supersort project. Improved the speed of the CM-2 library sort routine by a factor of ten, Summer 1990.

Technical Advisory Boards

Socure, May 2013–present.

Mushroom Networks, February, 2007–present.

Agami, October, 2004–August 2008 (folded).

Personity, October, 2000–October, 2002 (acquired by Openwave Systems, Inc.).

Eizel Technologies, September, 2000–April, 2003 (acquired by Nokia Corp.).

Kuokoa Networks, July, 2000–November, 2002 (folded).

LaunchCyte <http://www.launchcyte.com>, May, 2000–October, 2002.

Storm Systems, February, 2000–June, 2000 (acquired by Redleaf).

IV. External Professional Activities

Co-Chair NSF CISE Advisory Committee Subcommittee on Midscale Infrastructure

ACM SIGCOMM Awards Chair, June 2011–present.

Elected ACM Member at Large, May 2006. Term: July 1, 2006–June 30, 2010.

Mentor, NSF Future Internet Architecture Summit, October 2009.

Member of ISAT (DARPA Information Science and Technology Study Group), September 2004–October 2005.

Co-Chair of the Organizing Committee for the DIMACS Special Year on Massively Parallel Computation, September 1993–August 1994.

Member of the DIMACS Executive Committee, July 1993–June 1994.

Editorial Positions

Associate Editor, *IEEE Transactions on Parallel and Distributed Systems*, November 2000–September 2002.

Guest Editor, Special Issue, “ACM Symposium on Parallel Algorithms and Architectures,” of *Theory of Computing Systems*, with Susanne E. Hambrusch, Vol. 32, No. 3, May/June 1999.

Managing Editor and Co-Founder, *Journal of Interconnection Networks (JOIN)*, August 1998–present.

Field Editor, *Discrete Mathematics and Theoretical Computer Science*, January 1996–October 2001.

Author of 65 referee reports for 24 journals.

Steering Committees

Member of the Steering Committee for the ACM Workshop on Hot Topics in Computer Networks (HotNets), November 2008–present.

Member of the Steering Committee for the Internet Measurement Conference (IMC), October 2004–November 2010.

Member of the Steering Committee (Treasurer) for the ACM Symposium on Parallel Algorithms and Architectures (SPAA), May 1991–August 1996.

Member of the Steering Committee/Advisory Board for the Dartmouth Institute for Advanced Graduate Studies in Parallel Computation (DAGS/PC), May 1991–August 1993.

Program Chair Service

Co-Chair of the Program Committee for the 3rd Workshop on Online Social Networks (WOSN 2010), June 2010.

Chair of the Program Committee for HotWeb 2006: the First IEEE Workshop on Hot Topics in Web Systems and Technologies (HOTWEB), November 2006.

Chair of the Program Committee for the 14th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA), August 2002.

Co-Chair of the Program Committee for the 1997 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '97), December 1997.

Organizer of a DIMACS workshop on Graph Embeddings and Parallel Architecture, January 1992.

Program Committee Service

Member of the Program Committee for the Eleventh USENIX Symposium on Networked Systems Design and Implementation (NSDI '14).

Member of the Program Committee for PAM 2013: Passive and Active Measurement Conference (PAM), March 2013.

Member of the Program Committee for the ACM CoNEXT Student Workshop, December, 2012.

Member of the Program Committee for the 20th IEEE International Conference on Network Protocols (ICNP), October, 2012.

Member of the Program Committee for the 12th IEEE International Conference on Peer-to-Peer Computing (P2P), September, 2012.

Member of the Program Committee for the ACM SIGCOMM 2012 Conference (SIGCOMM), August, 2012.

Member of the Program Committee for the 26th ACM International Conference on Supercomputing (ICS), June 2012.

Member of the Program Committee for the 38th International Colloquium on Automata, Languages and Programming (ICALP), July 2011.

Member of the Program Committee for the Eighth USENIX Symposium on Networked Systems Design and Implementation (NSDI '11), March-April 2011.

Member of the Program Committee for the 6th International Conference on emerging Networking EXperiments and Technologies (CoNEXT), November 2010.

Member of the Program Committee of the First ACM SIGCOMM Workshop on Green Networking, August 2010.

Member of the Program Committee of the 9th International Workshop on Peer-to-Peer Systems (IPTPS), April 2010.

Member of the Program Committee of the ACM SIGMETRICS 2010 Conference, June 2010.

Member of the Program Committee of the World Wide Web 2010 Conference (WWW), April 2010.

Member of the Program Committee for PAM 2010: the Eleventh Passive and Active Measurement Conference (PAM), April 2010.

Member of the Program Committee for the Sixth USENIX Symposium on Networked Systems Design and Implementation (NSDI '09), April, 2009.

Member of the Program Committee for the Seventh ACM Workshop on Hot Topics in Computer Networks (HotNets-VII), October, 2008.

Member of the Program Committee for the Second IEEE Workshop on Hot Topics in Web Systems and Technologies (HotWeb 2008), October, 2008.

Member of the Program Committee for the Sixteenth IEEE International Conference on Network Protocols (ICNP 2008), October, 2008.

Member of the Program Committee for the ACM SIGCOMM 2007 Conference (SIGCOMM), August, 2007.

Member of the Program Committee for the Twenty-Sixth Annual ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing (PODC 2007), August 2007.

Member of the Program Committee for PAM 2007: the Eighth Passive and Active Measurement Conference (PAM), April 2007.

Member of the Program Committee for the Internet Measurement Conference (IMC), October 2005.

Member of the Program Committee for the ACM SIGCOMM 2005 Conference (SIGCOMM), August 2005.

Member of the Program Committee of the World Wide Web 2005 Conference (WWW) - Performance and Reliability track, May 2005.

Member of the Program Committee for the Workshop on Real-World Large Distributed Systems (WORLDS), December 2004.

Member of the Program Committee for the Workshop on Combinatorial and Algorithmic Aspects of Networking (CAAN), August 2004.

Global Chair of the Program Committee for Topic 11: Routing and Communication in Interconnection Networks, European Conference on Parallel Computing (Euro-Par 2002), August 2002.

Member of the Program Committee for the Workshop on Performance and Architecture of Web Servers (PAWS-2001), June 2001.

Vice Chair of the Program Committee for the International Conference on High Performance Computing (HiPC 2001), December, 2001.

Vice Chair of the Program Committee for Topic 06: Complexity Theory and Algorithms, European Conference on Parallel Computing (Euro-Par 2001) August, 2001.

Member of the Program Committee for the 20th Annual ACM Symposium on Principles of Distributed Computing (PODC '01), August 2001.

Member of the Program Committee for the IEEE International Symposium on Cluster Computing and the Grid (CCGrid 2001), May 2001.

Member of the Program Committee for the 5th Annual International Computing and Combinatorics Conference (COCOON '99), July 1999.

Vice Chair of the Program Committee for Topic 15: Routing and Communication in Interconnection Networks, European Conference on Parallel Computing (Euro-Par 1999), August 1999.

Member of the Program Committee for the 1999 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '99), June 1999.

Member of the Program Committee for the 2nd International Workshop on Discrete Algorithms and Methods for Mobile Computing and Communications (DIAL M for Mobility), October 1998.

Member of the Program Committee for the third Workshop on Randomized Parallel Computing (WRPC), March 1998.

Member of the Program Committee for Computing: The Australasian Theory Symposium (CATS), February 1998.

Member of the Program Committee for the 9th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA), June 1997.

Member of the Program Committee for the second Workshop on Randomized Parallel Computing (WRPC), April 1997.

Member of the Program Committee for the 8th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA), January 1997.

Vice-chair of the Program Committee for the 1996 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '96), June 1996.

Member of the Program Committee for the Workshop on Randomized Parallel Computing (WRPC), April 1996.

Member of the Program Committee for the 6th Annual IEEE Symposium on Parallel and Distributed Algorithms (SPDP), October 1995.

Member of the Program Committee for the 9th International Parallel Processing Symposium (IPPS), April 1995.

Member of the Program Committee for the 1994 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '94), December 1994.

Member of the Program Committee for the 5th Annual IEEE Symposium on Parallel and Distributed Processing (SPDP), October 1994.

Member of the Program Committee for the 26th Annual ACM Symposium on Theory of Computing (STOC), May 1994.

Member of the Program Committee for the 5th Annual ACM–SIAM Symposium on Discrete Algorithms (SODA), January 1994.

Member of the Program Committee for the 5th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA), June 1993.

Grant Proposal Reviewing

Member of NSF Proposal Review Panel, 2011.

Member of NSF Proposal Review Panel, 2010.

Member of NSF Proposal Review Panel, 2007.

Member of NSF Proposal Review Panel, 2005.

Member of NSF SBIR Review Panel, 2004.

Member of NSF Proposal Review Panel, 2002.

Member of NSF Proposal Review Panel, 2001.

Reviewer of 9 grant proposals for 3 funding agencies (prior to NSF panel review process).

V. Contracts and Grant Support

PI USAF Award FA8750-11-1-0262 *A Massive Data Approach to Geolocation*. October 2011 - September 2012: \$225,000. October 2012 - October 2013: \$199,999.

PI USAF Award FA8750-10-2-0193 *Mapping the Whole Internet with Passive Measurements*, July 2010 - July 2011. \$50,000.

Co-PI NSF NeTS Grant CNS-0520192 *NeTS ProWiN: Self-Managing Wireless Networks: Bringing Order to Chaotic Wireless Deployments*, September 2005–August 2009, \$750,000.

Co-PI NSF Grant CNF-0433540 *Cybertrust Center: Security Through Interaction Modeling (STIM)*, October 2004–September 2008, \$5,208,090.

PI NSF NeTS Grant CNF-0435382 *NeTS-NR: A Measurement-Driven Approach to Internet Protocol and Systems Design*, September 2004–August 2010, \$1,244,525.

Claude Worthington Benedum Foundation *Center for Appalachian Network Access (CANA)*, June 2003–June 2005, \$125,000.

Appalachian Regional Commission *Center for Appalachian Network Access (CANA)*, June 2003–December 2004, \$125,000.

IL (Ike) Morris *Center for Appalachian Network Access (CANA)*, May 2004, \$100,000.

MountainTop Technologies *Center for Appalachian Network Access (CANA)*, \$15,000.

Co-PI NSF Grant CCR-0205523 *ITR: Scalable Molecular Electronics*, September 2002–August 2004, \$1,500,000.

Coauthor of proposal NSF-CNPq Collaborative Research Grant CCR-9900304 : *Parallel Elimination Orders with Applications in Operations Research and Scientific Computing*, September 1999–August 2002, \$199,094.

PI ARPA Contract N00014-95-1-1246, *Algorithmic methods for communication, computation, and memory management in scalable HPC systems*, July 1995–July 1998, \$1,192,374.

NEC Research Institute Fellowship, February 1995–June 1995, \$22,762.

National Science Foundation Young Investigator Award CCR-94-57766, 1994–1998, \$205,530.

VI. Teaching

Duke University

COMPSCI 296.3 Algorithms in the Real World, Spring 2010, 2011.

COMPSCI 230 (formerly COMPSCI 102) Discrete Mathematics for Computer Science, Fall 2007, 2009, 2010, 2011, 2012.

COMPSCI 514 (formerly COMPSCI 214) Computer Networks and Distributed Systems, Spring 2008, 2012, 2013.

Carnegie Mellon University

15-410 Operating System Design and Implementation, Spring 2007, 2006, 2005, 2004, with David Eckhardt.

15-853 Algorithms in the Real World, Fall 2005, 2003, 2002, 2000, with Guy Blelloch.

15-213 Introduction to Computer Systems, Spring 2003 (with Seth Goldstein), 2001 (with Guy Blelloch).

15-441 Computer Networking, Fall 2001 (with Srinu Seshan), Spring 2009 (with Peter Steenkiste).

15-251 Great Theoretical Ideas in Computer Science, Spring 2000, with Steven Rudich.

15-299 Mathematical Foundations of Computer Science, Spring 1998.

15-740 Basic Computer Systems, Fall 1997, 1996, 1995, with Randy Bryant.

15-211 Fundamental Structures of Computer Science I, Spring 1997 (with Guy Blelloch, Gary Miller, and Danny Sleator), 1996 (with Avrim Blum and Danny Sleator), 1995 (with Avrim Blum), 1994 (with Avrim Blum, Jim Morris, and Danny Sleator).

15-840(A) Advanced Topics in Computer Systems: Introduction to Parallel Computer Architecture, Fall 1994, with Adam Beguelin.

15-850(A) Advanced Topics in Theory: Advanced Parallel Algorithms, Fall 1994, with Gary Miller.

Massachusetts Institute of Technology

18.996 Topics in Theoretical Computer Science: Internet Research Problems, Spring 2002, with Tom Leighton, Ravi Sundaram, and Shang-Hua Teng

6.046/18.410 Introduction to Algorithms, Fall 1998, with Shafi Goldwasser.

6.849/18.436 Advanced Parallel and VLSI Computation, Spring 1993, with Tom Leighton.

6.84s Parallel Algorithms and Architectures, Summer 1989, 1988, 1987, teaching assistant.

6.848/18.435 Theory of VLSI and Parallel Computation, Fall 1986, teaching assistant.

Princeton University

CS 597E Parallel Algorithms and Architectures, Fall 1992.

CS 597E Parallel Algorithms and Architectures, Spring 1991, with Bob Tarjan.

Southern Methodist University

CS 3358 Data Structures, Summer 1986.

VIII. Advising

Current Ph. D. Students

Bala Chandrasekaran, Duke University.

Yin Lin, Duke University.

Graduated Ph. D. Students

S. L. (Maverick) Woo, Carnegie Mellon University (Co-Chair with Guy Blelloch), *Heterogeneous Decomposition of Degree-Balanced Search Trees and Its Applications*, May 2009.

Charlie Garrod, Carnegie Mellon University (Co-Chair with Chris Olston), *Putting the "Scalability" into Database Scalability Services*, August 2008, Visiting Assistant Professor, Swarthmore College.

Amit Manjhi, Carnegie Mellon University (Co-Chair with Todd Mowry and Chris Olston), *Increasing the Scalability of Dynamic Web Applications*, March 2008, Google, Inc.

Shuheng Zhou (ECE), Carnegie Mellon University (Co-Chair with Greg Ganger), *Routing, Disjoint Paths, and Classification*, July 2006, Assistant Professor, University of Michigan.

Konstantin Andreev (Math/ACO), Carnegie Mellon University, *Approximation Algorithms for Network Design and Graph Partitioning Problems*, December 2005, Openheimer Funds.

Hal Burch, Carnegie Mellon University (Co-Chair with Gary Miller), *Measuring an IP Network in situ*, May 2005, Google, Inc.

Kunwadee (Kay) Sripanidkulchai (ECE), Carnegie Mellon University (Co-Chair with Hui Zhang), *A Measurement Driven Approach to Designing Peer-to-Peer Systems*, May 2005, IBM Research.

Claudson Bornstein, Carnegie Mellon University (Co-Chair with Gary Miller), *Nearly Optimal Gaussian Elimination*, August 1998. Professor Adjunto (Associate Professor), Universidade Federal do Rio de Janeiro.

Andréa Richa, Carnegie Mellon University (Chair), *On Distributed Network Resource Allocation*, June 1998. Associate Professor, Arizona State University.

Anja Feldmann, Carnegie Mellon University (Co-Chair with Danny Sleator), *On-line Call Admission for High-Speed Networks*, September 1995. Professor, Deutsche Telekom Laboratory/Technical University of Berlin.

Ramesh Sitaraman, Princeton University (Principal Reader), *Communication and Fault Tolerance in Parallel Computers*, January 1993. Professor, University of Massachusetts, Amherst. (Technically, Bob Tarjan was Ramesh's advisor.)

Graduated Masters Students

Kyle Moses, Duke University, *Improving IP-based Geo-Location through Internet Topology and Geospatial Datasets*, March 2013.

Jannie Tan, Duke University, *TCP-plb: TCP with Packet Level Load-Balancing*, April 2012.

Jack Lin (5th-year Masters) Carnegie Mellon University, *Detecting BGP Misconfigurations*, December 2003.

Ph.D. Thesis Committees Served On

Ingmar Poese, Technische Universität Berlin, April 2013.

Xin Liu, Duke University, July 2012.

Souvik Sen, Duke University, July 2012.

Eduardo Cuervo, Duke University, May 2012.

Yang Liu, Duke University, December 2011.

Bernhard Ager, Technische Universität Berlin, June 2011.

Ionut Constandache, Duke University, March 2011.

Mukesh Agrawal, Carnegie Mellon University, February 2011.

Tudor Dumitras, Carnegie Mellon University, December 2010.

Michael Dinitz, Carnegie Mellon University, May 2010.

Shoba Venkataraman, Carnegie Mellon University, September 2008.

David McWherter, Carnegie Mellon University, August 2008.

Nils Kammenhuber, Technical University of Munich, June 2008.

Florin Oprea, Carnegie Mellon University, March 2008.

Asad Samar, Carnegie Mellon University, August 2006.

Ningning Hu, Carnegie Mellon University, April 2006.

Takayuki Osogami, Carnegie Mellon University, May 2005.

Adam Wierman, Carnegie Mellon University, February 2005.

Sanjay Rao, Carnegie Mellon University, August 2004.

Eugene Ng, Carnegie Mellon University, December 2003.

Harald Räcke, University of Paderborn, Germany, December 2003.

Nikhil Bansal, Carnegie Mellon University, December 2003.

Geoff Atkinson, Carnegie Mellon University (MATH/ACO), April, 2003.

Christian Scheideler, University of Paderborn, Germany, June 2000.

Carl Burch, Carnegie Mellon University, April 2000.

Girija Narlikar, Carnegie Mellon University, February 1999.

Ye Zhang, Carnegie Mellon University (Architecture), January 1999.

Berthold Vöcking, University of Paderborn, Germany, December 1998.

Daniel Tunkelang, Carnegie Mellon University, November 1998.

Margaret Reid-Miller, Carnegie Mellon University, May 1998.

Rajaraman Rajmohan, University of Texas at Austin, August 1997.
Jonathan Hardwick, Carnegie Mellon University, July 1997.
Ville Leppänen, University of Turku, Finland, November 1996.
Keith Gremban, Carnegie Mellon University, April 1996.
Louxin Zhang, University of Waterloo, Canada, (External Examiner), February 1995.

IX. University Service at Duke University

Chair, Pamela and Jack Egan Professorship in Entrepreneurship Search Committee, April 2011–April 2012.
Patent Policy Committee, April 2011–present.
Entrepreneurship Program for Undergraduates Committee, August 2011–April 2012.
Faculty Recruiting Committee, 2010, 2011, 2012.

IXb. University Service at Carnegie Mellon

CSD Admissions Committee, Spring 2006, 2007.
Herbert A. Simon Visiting Scholar Committee, December 2005–July 2009.
SCS Review Committee, October 2005–May 2007.
CSD Teaching Track Recruiting Committee, Spring 2005, 2006.
Distinguished Lecture Series Chair, June 2005–June 2007.
Newell Award Committee, May 2004.
CSD Speakers Club, October 2003–July 2009.
Innovation Review Panel, Innovation Transfer Office, February 2003, June 2002.
University Committee on Tenure Appointments, November 2001–November 2003.
CSD Faculty Recruiting Committee, October 1997–May 1998, January 2009–May 2009.
CSD Doctoral Review Committee, September 2002–August 2007, January 2000–December 2001, May 1997–August 1998.
SCS/ACM Distinguished Dissertation Committee, May 2001–August 2007, May 1997–August 1997.
CSD ACM Thesis Award Committee, May 1995–August 1995.

X. Philanthropic and Volunteer Activities

Member of the Board, Andrew Carnegie Society, July 1, 2005–July 30, 2007.
Member of the Board, Mentoring Partnership of Southwestern Pennsylvania, December 2003–February 2006.
Co-Founder of CANA (Center for Appalachian Network Access) <http://www.canacenter.org>, June 2003–present.
Big Brother to Jerome Kelley, Big Brothers and Big Sisters of Greater Pittsburgh, January 1997–June 2005. 2004 Big Brother of the Year, Greater Pittsburgh.

XI. Personal Information

Born May 9, 1963. U.S. citizen. Avid runner, infielder, and hockey player. Fraternity house manager and President of Tau Beta Pi chapter in college. High school track letterman and student senator.

Photographed the world's longest slide rule for the *Guinness Book of World Records*.

Created Avatar, an interactive multi-player dungeons and dragons game, with A. Shapira and C. D. Sides. Since 1979 this program has recorded over one million user hours on the PLATO system at the University of Illinois.